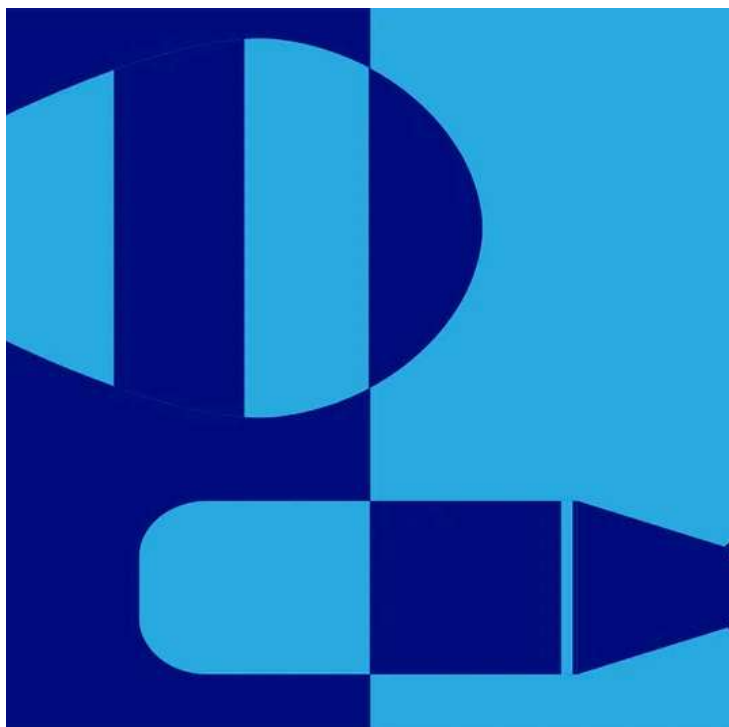


[LANL Home](#) [Media](#) [Publications](#)  
[The Vault](#)

# A Tale of Two Bomb Designs



## Why were both Little Boy and Fat Man created?

OCTOBER 10, 2023

Little Boy and Fat Man.

These weapons were, however, as different as their monikers imply. Little Boy was a uranium, gun-type weapon, whereas Fat Man was a plutonium, implosion-style weapon. Two types were needed because there was only enough uranium for one gun-type weapon, and the U.S. government knew it would need to make more than one weapon. The insurmountable challenges associated with a plutonium gun-type design prompted the shift to the implosion-style weapon.

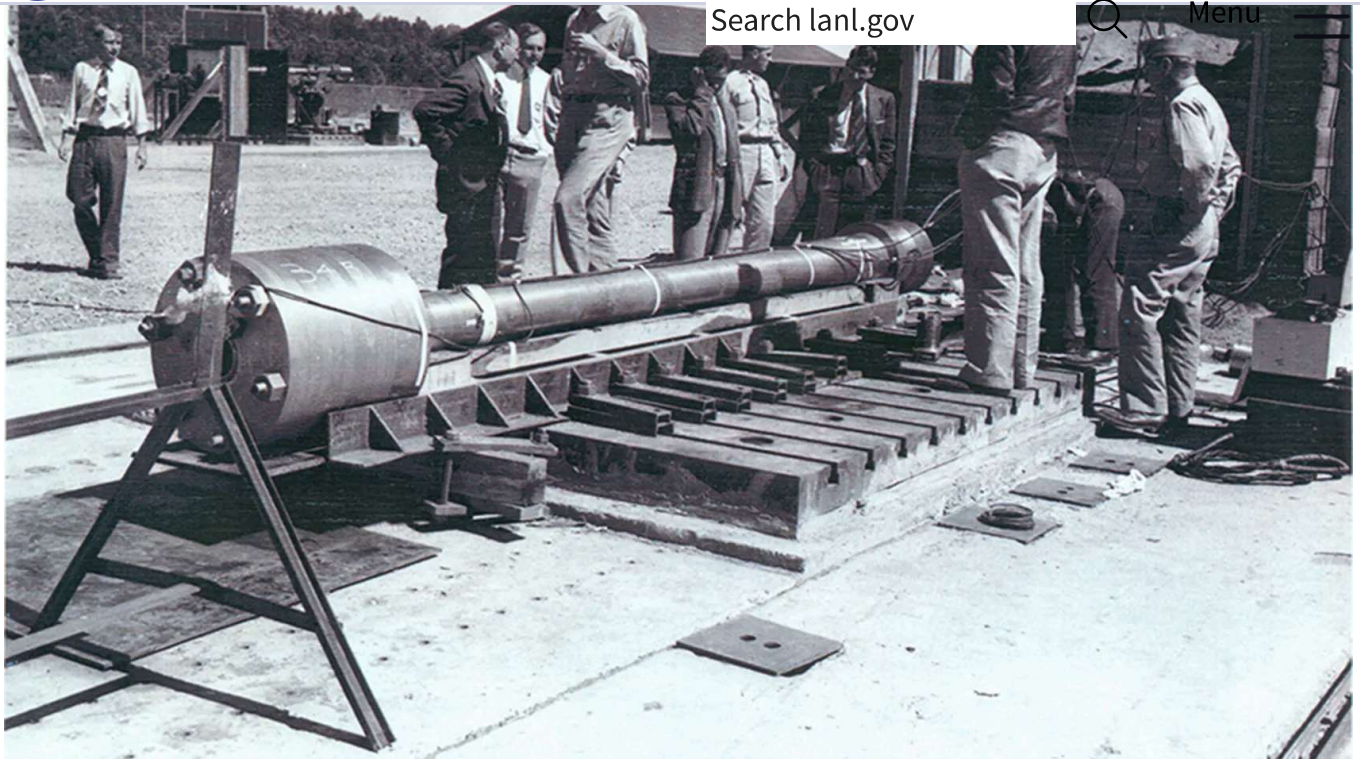
## Creating atomic bombs

Consider the setting of the Second World War. Amid the impending resolve to end the war and stop the daily death toll of thousands, the scientists, engineers, and military personnel at Los Alamos intensely collaborated over 27 months to build two types of bombs.

Wartime troubles were unavoidably linked to practical concerns, such as fitting bombs into the B-29 bomb bay to carry the weapons into combat and building components that could tolerate the harsh conditions of high-altitude falls. Developing bombs was not a routine engineering project, according to *Critical Assembly: A Technical History of Los Alamos during the Oppenheimer Years, 1943–1945*. Many gaps existed in the scientific information needed to create

the atomic bombs. It would require a full understanding of nuclear physics, chemistry, explosives, and hydrodynamics.

Jobs | News & Media ▼ | Resources ▼



The failed plutonium gun-type design, called Thin Man.

“The most daunting technical problem facing Los Alamos,” said Laboratory historian Roger Meade, “was how to fashion the limited quantities of two very different [fissile] materials, uranium-235 and plutonium-239, into combat weapons.”

Proper bomb design broadly depends on sufficient fissile material to sustain a nuclear reaction; assembly technology, such as gun-type or implosion; and the necessary specifications, such as dimensions, reliability, and efficiency.

The simplest bomb design is the gun-type assembly device, in which an explosive propellant is used to fire one subcritical piece of fissile material down a “gun barrel” into another piece of fissile material.

“[Little Boy’s design] is much simpler than Fat Man,” said Glen McDuff, retired Los Alamos weapons scientist. “[Little Boy] could be tested without an explosive test and was guaranteed to work.”

Early on, the gun-type design was thought to be feasible for both uranium-235 and plutonium-239. As such, research for the lower-priority implosion design was viewed as a program to fall back on should unexpected problems arise in developing the gun-type design. However, priorities were soon to shift.

# Why did we need both Little Boy and Fat Man?

From the U.S. military's point of view, it would take more than one bomb to help end World War II. Originally, the plan was to develop two gun-type bombs, a uranium-235 device named Little Boy and a plutonium-239 device named Thin Man, according to Critical Assembly.

However, when it became apparent that the Thin Man bomb had unworkable challenges and would not be successful in combat, a different type of bomb had to be designed.

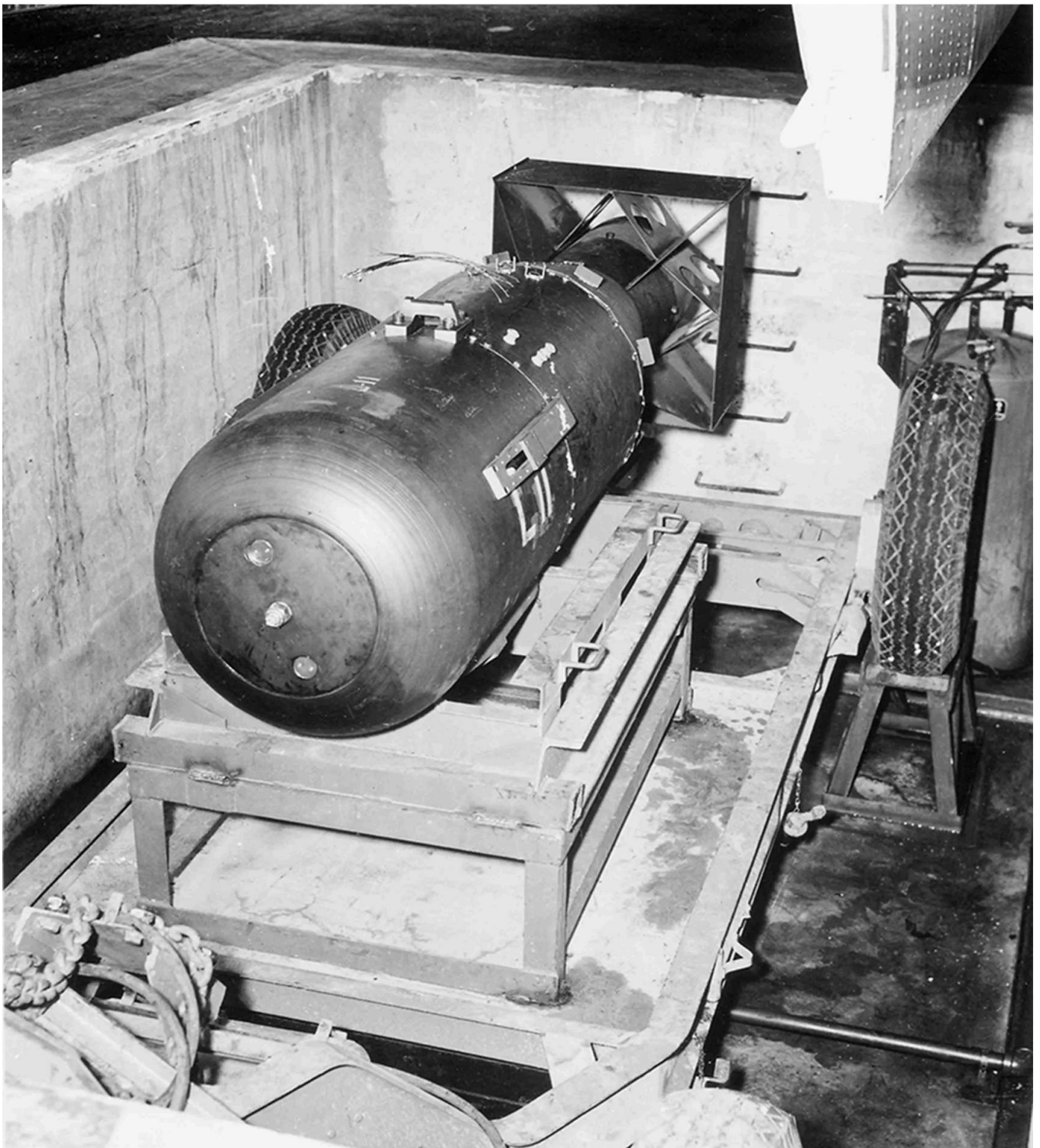
General Leslie Groves, leader of the Manhattan Project (the U.S. government's top-secret effort to create the atomic bomb), did not want to lose the time and money spent on plutonium production. As such, within days of Lab Director J. Robert Oppenheimer disclosing the problems with Thin Man, scientists shifted their focus to an implosion assembly method that could utilize plutonium. This implosion design would come to be named Fat Man.

Little Boy and Fat Man used different components and entirely separate methods of construction in order to successfully detonate, according to the Atomic Heritage Foundation's article "Science behind the Atom Bomb."



The original Fat Man (top) and Little Boy (bottom) atomic bombs created at the secret lab in Los Alamos.





## Why wasn't Little Boy tested with Fat Man?

A full-scale test of Little Boy was impossible because producing one Little Boy would use all of the purified uranium-235 that had been collected at the time. The separation of the uranium-235 isotope from uranium-238 in natural uranium was an expensive and difficult process that could not be relied upon to deliver material quickly, according to Critical Assembly. However, many tests were run on bombs that had most of the components minus the fissionable material, according to Groves's autobiography *Now It Can Be Told: The Story of the Manhattan Project*.

Owing to confidence in the uranium-235 gun-type bomb design and the lack of extra fissile material for experimental trials, testing it before combat use was deemed unnecessary, according to Alan Carr, senior historian at the Lab's National Security Research Center. Moreover,

field tests conducted with uranium-235 prototypes provided assurance about the gun-type assembly method.

“Although a full-scale nuclear explosive test was not conducted, every component of Little Boy was rigorously tested right here at Los Alamos,” Carr said. “The scientists were not simply confident Little Boy would work, they knew Little Boy would work—it was a mathematical certainty.”

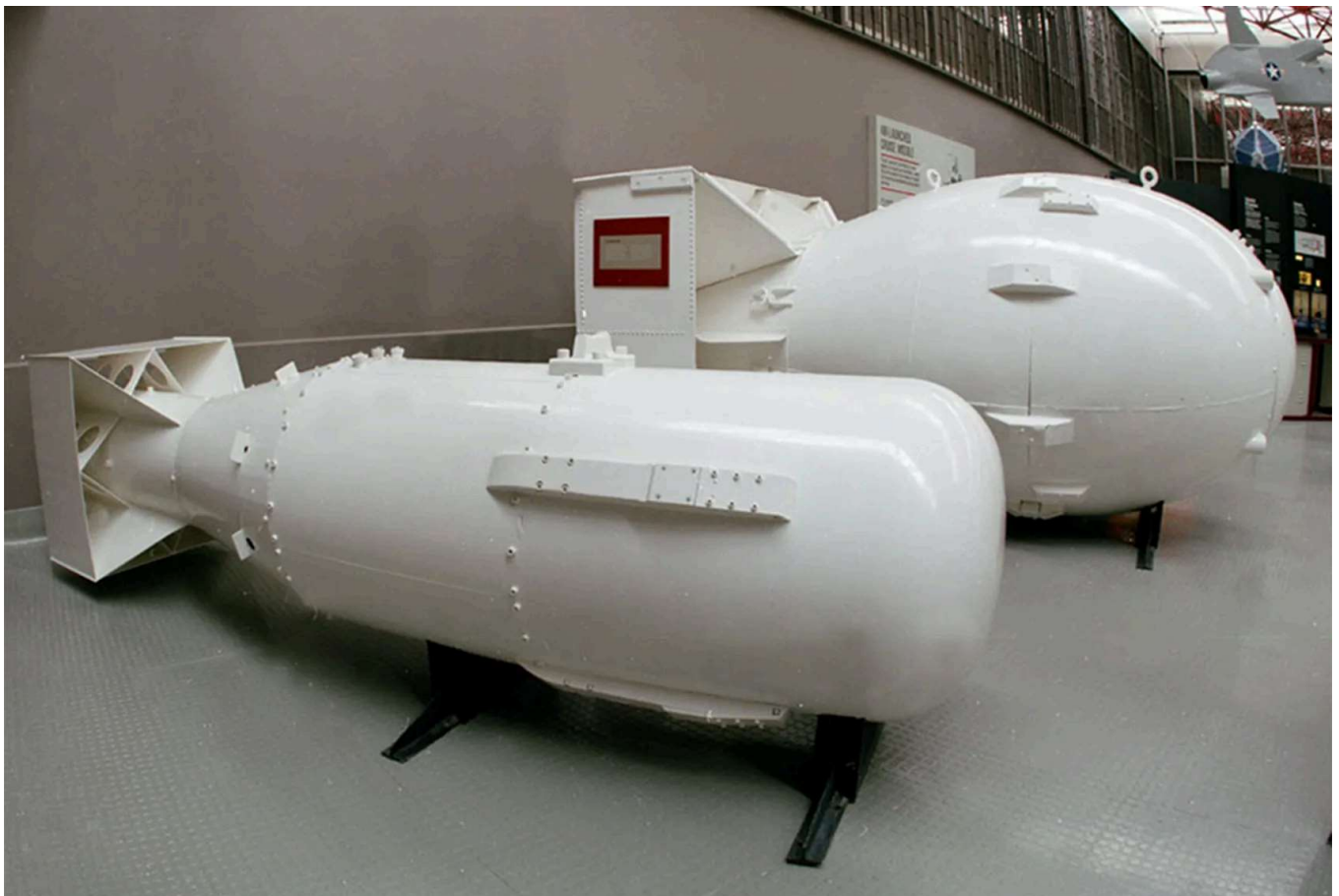
## A third bomb?

The question often arises: Did the United States have a third bomb ready for combat, following the release of Little Boy and Fat Man above Hiroshima and Nagasaki?

Yes, there was indeed a third bomb forthcoming if Japan didn’t surrender after the second bomb was dropped. This third bomb, sometimes referred to as the second Fat Man or the Third Shot, was another plutonium-239 implosion bomb.

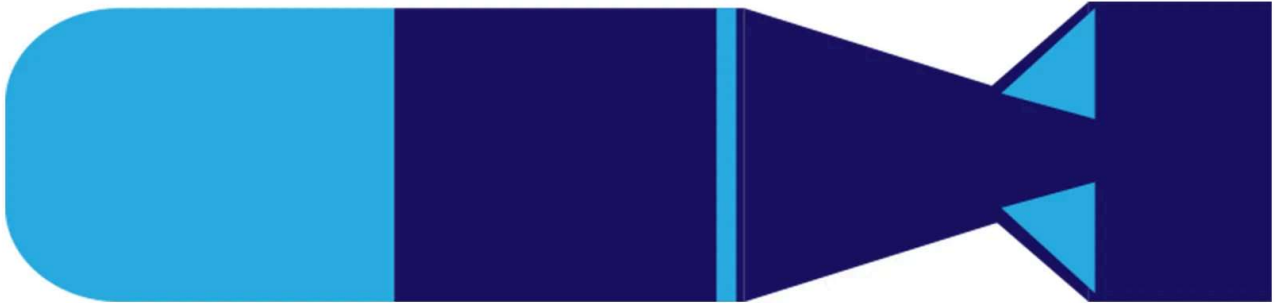
Groves’s directive, written on July 23, 1945, just weeks before Little Boy and Fat Man were released, stated that additional bombs would be delivered for use against the Japanese targets once they became available. The plutonium production facilities at Hanford in Washington state continued to work at capacity. Production of materials for assembly of a third bomb was well underway when Japan officially surrendered on September 2, 1945.

A copy of Groves’s letter is part of the NSRC’s unclassified collections.



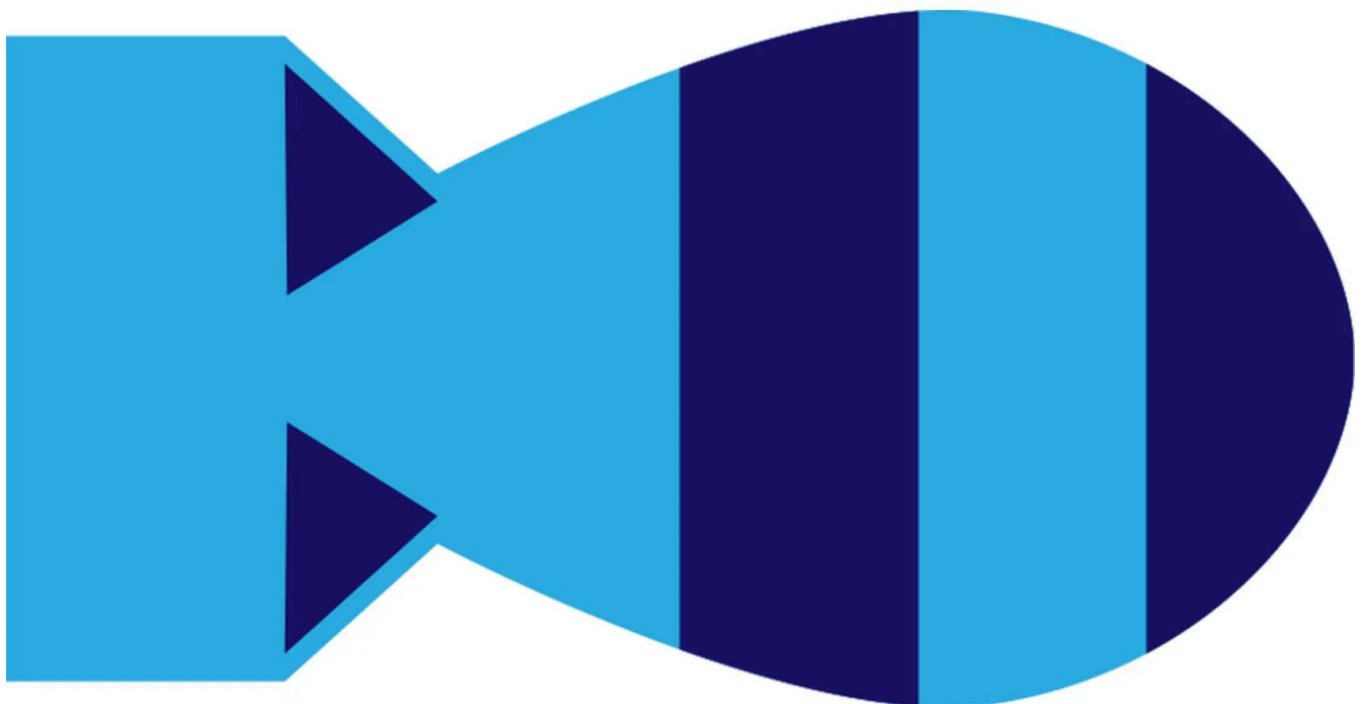
Models of Little Boy and Fat Man.

# What's what: A look at the Manhattan Project-era weapons



## Little Boy

The first of two atomic bombs to be used in combat, the uranium gun-type weapon was released above Hiroshima on August 6, 1945. The weapon was 9,700 pounds, 10 feet long, and just over 2 feet in diameter.



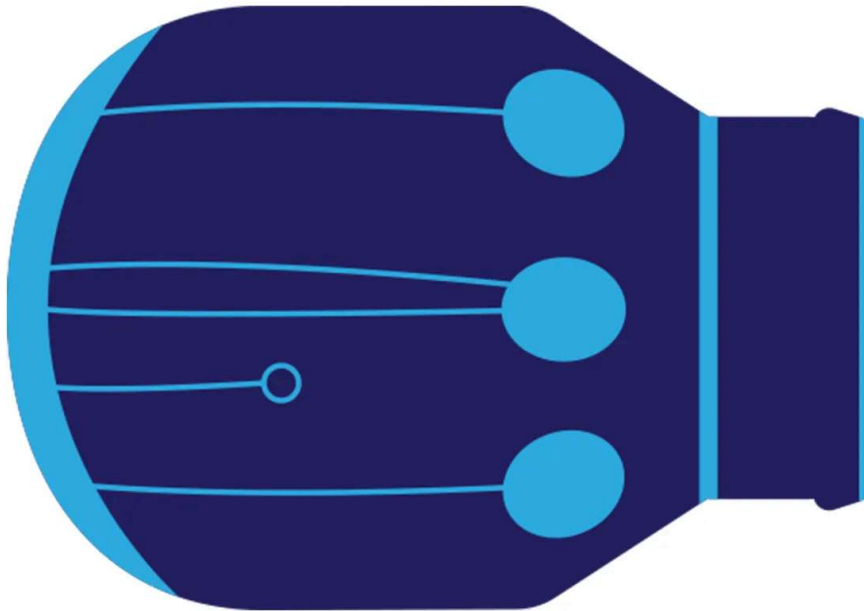
### **Fat Man**

The second of two atomic bombs to be used in combat, the plutonium implosion-type weapon was released above Nagasaki on August 9, 1945. The bomb was a weaponized version of The Gadget that was detonated during the Trinity test in the New Mexico desert on July 16, 1945. Fat Man was 10,800 pounds, nearly 11 feet long, and 5 feet in diameter.



### **Thin Man**

The attempt to develop a gun-type plutonium weapon was not successful and ultimately abandoned.



### **The Gadget**

The world's first-ever atomic device detonation occurred in the New Mexico desert during the Trinity test. It verified that an implosion-type plutonium bomb (Fat Man) would be successful when released above Japan just weeks later. The explosive power from The Gadget's detonation was equivalent to around 21,000 tons of TNT; its mushroom cloud grew to about 3,280 feet wide with a column of smoke in excess of 40,000 feet high.